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ABSTRACT

Project THISTLE (Thinking Skills in Teaching and Learning) was developed by Montclair State College (New Jersey) faculty in collaboration with the Newark, New Jersey, public schools. The project is designed to improve the basic skills of urban college-bound high school students by working with their teachers in an integrated process of curriculum and staff development. An interdisciplinary approach focuses on thinking as an essential, integral part of both subject area learning and "higher order" basic skills development, particulary reading comprehension, analytic writing, and mathematical reasoning and problem solving. Since 1980, more than 100 Newark teachers have participated in the project's program of graduate course work in curriculum development and basic skills instruction, a supervised classroom implementation, and elective professional development activities. Hundreds more have engaged in less intensive project activities. Analysis of pretest and posttest scores of students in grades 10-12 found that the students doubled their annual growth rate in reading comprehension, from an average rate of 6 months in a 10-month period to a rate of 12 months, demonstrating the effectiveness of the project. (MLF)

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Effects on Student Achievement of Project THISTLE: Thinking Skills in Teaching and Learning

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Project THISTLE is a curriculum and staff development program designed to improve the pre-college preparation of urban students. The support of the Fund for New Jersey, the Victoria Foundation, the Jessie Smith Noyes Foundation, the New Jersey Board of Higher Education and Montclair State College are gratefully acknowledged.

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Project THISTLE: Thinking Skills in Teaching and Learning was designed to improve the basic skills of college bound urban students by working with their teachers in an integrated process of curriculum and staff development. The major emphasis of Project THISTLE is on the preparation of classroom teachers to strengthen creative, logical and critical thinking abilities of their students, helping them to develop the interest, willingness, and ability to engage in intellectually active, constructive, and reflective encounters with ideas within the content areas.

Project THISTLE synthesizes the two processes of curriculum and staff development, and cuts across disciplines to focus on the improvement of thinking as an essential, integral part of both subject area learning and basic skills development. Underlying Project THISTLE is the belief that thinking skills are critical components of both the basic skills of reading comprehension, analytic writing, and mathematical problem solving, and successful classroom performance. Thus, it is anticipated that improvement in thinking skills will be reflected in improvement in performance both on traditional standardized tests of basic skills and in classroom activities.

The basic design of Project THISTLE involves the participating teachers in three "phases" of staff/curriculum development over a period of three years and more. The three overlapping but sequential phases in which teachers engage are: (1) graduate course work in curriculum development and basic skills instruction, (2) classroom implementation of individually prepared curriculum plans, and (3) extension activities depending upon individual personal and professional needs, strengths, and preferences. At present, more than 100 teachers from 10 high schools and three elementary schools are actively engaged in Project THISTLE.

Project THISTLE is an "integrated curriculum and staff program" as it provides teachers with guided instruction by college faculty in the use of curriculum resources in the planning process, instruction in the nature of higher order basic skills (or thinking skills), and guidance in the skillful orchestration of a wide range of resources--materials, strategies, activities, content, and evaluation techniques--to improve thinking skills. Teachers develop more complete, more thoughtful, more consistent versions of their own curricular plans with particular attention to the development of thinking skills, and put these plans into effect with their students, with the help and support of college faculty.

Project THISTLE was initially conceived by Montclair State College faculty and planned as a cooperative higher education/local education agency venture involving Montclair State College and the Newark public schools.

Models of the educational change process had been examined prior to introducing the program to Newark school personnel, and change strategies were adopted. These strategies included securing and maintaining the cooperation of administrators and supervisors, avoiding domination of the program by

college faculty, implementing extensive follow-up activities, and providing professional and personal incentives. In planning strategies to assure program success, attention was given to the concepts of relative advantage, compatibility, and divisibility (Oxman and Michelli, 1981; 1984).

In Project THISTLE, "thinking" - "reflective thinking" - refers to mental processes that go beyond memorization and require intellectually active consideration of facts, concepts, and ideas. Reflective thinking includes logical reasoning, imaginative, creative mental processes, and critical analysis and judgment. When teachers skillfully guide students to think reflectively about subject matter, first resistance ("I hate it when you have to explain!"), then engagement ("Wait a minute! Wait a minute! Wait a minute! I've got to turn that around in my mind!"), then confident application ("How could they have done that without even thinking about it?") typically ensue.

Persistent and consistent emphasis on thinking in the classroom may have other effects as well. On the secondary level, improvement in basic skills requires that students engage in an active search for meaning, for comprehension and expression cannot take place without the structuring and restructuring of images and ideas.

Thinking and Basic Skills

How do thinking and the basic skills relate to each other? A basic skill may be thought of as any skill that is a prerequisite for learning or for life, although we typically associate the term with primary education. In the earliest grades, almost all children master the associations between letters and sounds, numbers and quantities, and learn to represent the symbols of language and mathematics on paper. They learn, too, to string together letters to make words, and to string together words into sentences. They learn to combine and to separate quantities. However, reading, writing and arithmetic involve far more than these basic elements, which mainly deal with symbolic representation of concrete experience. Beyond these elements and yet well within the "three r's" lie thinking and learning.

Thinking is indeed basic to education, but it should not be considered as a separate "skill" to be added to the traditional list of three. The basic skills are - or should be reconceptualized as - thinking skills themselves. Our very narrow, traditional view of the basic skills must be exchanged for a definition which recognizes the need for the students' intellectually active involvement in searching for meaning. Through reading, through listening to one's teacher and classmates, through oral and written expression, through mathematical analysis, students (if they are encouraged to do so) construct, reconstruct, and integrate new information and ideas. This process is thinking. Typically, students do very little thinking in classrooms at any level of education and least of all in classrooms in which narrowly defined approaches to basic skills or to content teaching is emphasized.

Reading and Thinking

Reading is at once the most important and the most misunderstood of school subjects. Students must learn to read in order to succeed in school, and their success in school is measured largely by their ability to read. Reading is, in a crucial sense, both a prerequisite for and a criterion of successful school achievement. There is, however, little agreement with regard to what is meant by reading, how reading is to be taught, how reading progress is to be measured, and how to help students who do not seem to "respond" to conventional instruction. Many of our most popular current methods and materials are based upon faulty or incomplete conceptions of the reading process, and upon a false dichotomy in our understanding of the teaching of reading and the teaching of subject matter. Reading comprehension and the understanding of the concepts and logic of subject matter are closely related to each other.

Reading is a dual process, involving both the decoding of the printed symbols of a written "message" into language and the comprehension of the meaning that is communicated. A fluent reader decodes words and sentences automatically into language. Most children are able to transpose printed symbols into another language form, such as speech, by the end of second grade, so that they can pronounce many words, phrases, and sentences that are far beyond their ability to comprehend. This ability is often taken as an indication that the student has learned to "read." It is often assumed, too, that children who score below grade level on standardized reading tests in the higher grades have not learned to "read" in this sense; however, most of them have indeed achieved this skill.

Nearly all children who have mastered this decoding process can indeed demonstrate that they understand the meaning of what they have read, provided that our examination of their reading ability is based on simple, short, straightforward, familiar narrative material--that is, on "easy" material. For instance, children can restate a simple reading passage in their own words, or answer simple factual questions based on the passage. Some students progress very, very slowly from this point in further reading achievement.

Beyond the primary grades, children differ most from each other not in terms of their ability to decode printed symbols or to understand simple narrative material, but in terms of their ability to comprehend discourse of increasing complexity and abstractness; not in terms of different numbers of reading skills mastered, that is, but in terms of the difficulty of the reading material that they can comprehend. Not surprisingly, the correlation between measures of reading comprehension and of general verbal ability is extremely high. Both types of tests reveal the student's ability to engage in reflective thinking--to relate, to infer, to analyze, to ponder, and to judge--with regard to more and more complex and abstract concepts and ideas. Therefore, teaching that results in the improvement of reading comprehension would be expected to be accompanied by a rise in the quality of thinking processes as expressed on verbal ability tests. Conversely, improvement in the quality of teaching, in terms of increased attention to helping children to understand the world through a variety of intellectually stimulating learning activities, would, it is expected, to be accompanied by improved reading comprehension. It may well be that there is very little difference at all between the two sets of abilities, and that activities that foster growth in one area will lead to growth in the other.

Thinking and Learning

According to Piaget (1970), cognitive growth occurs when children reconstruct their understanding of the world, creating increasingly complex and abstract "structures" to organize new knowledge, concepts, ideas, and relationships among ideas in their minds. This process of reconstruction is by its nature an intellectually active one. Gains are made when children confront meaningful intellectual dilemmas which they seek to resolve. Little is gained in an educational setting in which students are expected to "absorb," passively, unrelated bits of information presented in a textbook or in a lecture. Little is gained without intellectual curiosity and challenge.

Unfortunately, much of classroom teaching involves the presentation by the teacher of factual information or the reviewing of a reading assignment with students answering simple factual questions to demonstrate that they have "learned" the material. Students are directed to "study"--that is, to memorize facts, definitions, even statements of principles. This feature of typical classroom instruction is nothing new. In his revision of his 1910 book, How We Think, John Dewey (1933) stated that:

> *It is hardly an exaggeration to say that too often the pupil is treated as if he were a phonographic record on which is impressed a set of words that are to be literally reproduced... Or, varying the metaphor, the mind of the pupil is treated as if it were a cistern into which information is conducted by a set of pipes that mechanically pour it in..." (p. 261)*

This practice "puts a premium on passivity of mind," according to Dewey. Reflective thinking, he continued, is the opposite of passivity. The art of teaching--of guided learning--he suggests, is very largely the art of posing stimulating and challenging questions so as to direct students' own inquiries, and facilitating the resolution of these challenges through observation, recollection, and "through reasoning into the meaning of material" (author's emphasis; Dewey, 1933; p. 266).

It does not matter whether the material--the subject matter information--is presented through a passage to be read, a film to be viewed, an event to be recollected or experienced, or a lecture to be heard. It is the selection of meaningful material and the preparation and follow-up that matter most. What Dewey called a "recitation" and what we would most likely call a "class discussion" must provide for intellectual activity--thinking--reasoning into the meaning of information that comprises the school subject's content.

Thinking is thus an integral part of both basic skills and content learning. Students are thinking when they reflect upon things, when they ponder and consider, when they figure out, when they make connections and see parallels. Students are thinking when they ask questions. They are thinking when they become aware that there is a system of conceptual logic underlying the material that they are learning, whether it is the structure of a short story, the expression of metric measurement in scientific notation, or the functions of a governmental executive. When students become aware of these logical systems, they discover that the world is not composed of isolated bits of material to be memorized, but ideas and patterns to reflect upon. When students are encouraged to do so, they eagerly engage in creative, productive thought and

discussion and writing, working toward sorting out and making connections among the ideas which they are confronted.

These ideas form the underpinnings of Project THISTLE (Thinking Skills in Teaching and Learning). In Project THISTLE, we have had the opportunity to see some of these ideas in practice through our intensive work in helping more than 100 secondary teachers to integrate instruction in basic skills--thinking skills--within their own curricular plans.

We are finding that instruction in basic skills can indeed be offered within the framework of existing high school curricula. We are finding that conceptualizing basic skills as thinking skills, an old idea, really, is quite new and exciting for many of our teachers. They have been able to confront their students with ideas, stimulate them with questions, and challenge them with assignments. After some resistance to the hard work of thinking, the students seem to find the new demands and experiences personally satisfying. The teachers find that the students seem "smarter"! And our evaluation results document significant improvement in growth rates in reading comprehension.

Cognitive growth and improvement in reading ability occur simultaneously to the degree that meaningful intellectual activity--reflective thinking--occurs in our classrooms. There is no difference in purpose between helping a young person to understand the world through reading, or express his/her understanding through writing and helping him or her to understand the world and express that understanding through other classroom events, and both aspects of teaching depend upon the quality of intellectual life in the classroom. The planning and use of appropriately selected, varied, well-balanced, well-sequenced, and well-integrated learning activities is essential. These activities must provide for the students to interact actively with the substance or content of the subject matter, through reflective thinking.

Students learn to think by confronting complex classroom activities which pose interesting, perplexing problems which have no obviously correct solution and which require reflective thinking for completion. Reflective thinking activities are not activities in the abstract. They have as their content the existing curriculum of the school. The task for teachers is to examine their curricula carefully and plan ongoing activities which maximize the opportunity for reflective thinking at appropriate points in content instruction.

It is our view that this emphasis on reflective thinking/reasoning skills must be made explicit. It is widely assumed that schools teach children to think, indirectly if not directly. Clearly, all curriculum guides and statements of educational goals list thinking as a primary objective. In fact, in many cases the emphasis on the achievement of minimum levels of basic skills as an end in itself has caused such higher level skills to be neglected, and teachers report that reflective thinking "has not been established and communicated as an important school goal" (Oxman and Barell, 1983). Textbooks, workbooks, and other printed materials upon which most curricula-in-use are based include, among their many usggested alternative activities, "thinking questions" or "extended assignments," many of which are considered difficult but also more interesting and exciting than routine schoolwork. Although these activities might be used in the development of thinking, they are often skipped in the press of time or because they are viewed as too hard for the children.

Some children, in some school settings, manage to become effective thinkers, creating their own meaningful connections and maintaining interest in the process despite lack of explicit attention to this aspect of learning. Others, however, never learn that schooling can be meaningful or exciting. Gradually, they lose interest in the world of knowledge and the intellect, as the natural curiosity of early childhood wanes and the tasks of schooling appear overwhelmingly complex and bewildering or trivial and worthless.

The ability to reason effectively is, in a sense, the most basic of the basic skills, even though traditional conceptions of basic skills have often ignored dealing with thinking explicitly or have even militated against the development of reflective thinking, in order to focus on the most minimum skills. If students are to learn to think reflectively, appropriate stress must be placed on thinking / reasoning skills as curriculum is modified, and the ethos of the school must be altered to make it clear that reflective thinking is valued in classroom "communities of inquiry."

Goals, Objectives, and Evaluation of Student Progress

Project THISTLE has been described as a collaborative curriculum and staff development program to improve the basic skills of urban college-bound students. Its major goal is to improve the opportunity for success in post-secondary education of students currently in high school. Within its conception of teacher planning as curriculum development and of basic skills as thinking skills to be developed through content instruction, let us look at the objectives which guide program activities through the three project phases.

Phase I is devoted mainly to graduate course work for teachers in curriculum development and in basic skills instruction. Stated formally, its objectives are that teachers will develop understanding of:

a. the role of teacher planning in curriculum and teaching.
b. the nature of thinking skills.
c. questioning techniques and other strategies to elicit student thinking.
d. continuity and expectation, and how to develop achievement motivation.
e. developing basic skills through content area instruction.

In Phase II, teachers implement the program with their students, with the guidance and support of their college instructors, colleagues, and school supervisors. Through the use of individually planned curriculum units which incorporate the development of thinking skills within content instruction, it is expected that teachers will have developed in their abilities to:

a. plan and conduct lessons which focus upon fundamental ideas and concepts, selecting content, strategies, materials, activities, assignments and evaluation techniques appropriate to curricular goals and objectives (teacher planning as curriculum development).
b. establish learning environments conducive to reflective thinking, in which teachers and students build upon each others' contributions and relate content information to prior knowledge and experience and to other aspects of school learning (nature of reflective thinking).
c. ask higher order questions and probe to elicit and clarify thinking; listen, redirect, facilitate discussion of issues, model reflective thinking when appropriate, provide many opportunities for students to engage in a variety of thinking activities and assignments.
d. provide continuity through ongoing assignments and activities within units; encourage active, responsible student behavior, including class participation, regular attendance and completion of work; make efficient use of the classroom time of both teachers and students (continuity and expectation).
e. use appropriate techniques to improve reading comprehension, analytic writing and mathematical problem solving within content instruction; use and clarify methods of inquiry appropriate to particular disciplines; analyze complex ideas in terms of components and parallel structures in prior experience (basic skills in content instruction).

Phase II also involves an evaluation of the effects of Project THISTLE on students. Formal student objectives are that, through the efforts of their

teachers, students will demonstrate:

a. improved reading comprehension as measured by standardized tests.
b. increased achievement motivation as measured by improved general acceptance of responsibility for learning (e.g. goal setting, class participation, completion of assignments, attendance).
c. improved ability to sustain engagement in challenging higher order thinking activities (e.g. reflective discussion and analysis, reading for comprehension, writing, etc.).
d. increased spontaneous use of reflective thinking to question, relate ideas, examine problems from multiple perspectives, etc.

Phase III, the part of the program devoted to extension activities, was designed to continue development in the objectives listed for Phases I and II on the part of teachers and students, and to provide for support to others in implementing the program. Project THISTLE participants were to join with administrators and supervisors in developing:

a. an increased understanding of the principles and objectives of Project THISTLE.
b. an increased understanding of their role in providing support for teachers implementing the program.
c. an increased willingness and ability to participate in planning and offering extension activities (workshops, etc.) within their schools.

Evaluation of Student Progress

As part of the evaluation of Project THISTLE, the standardized test scores in reading comprehension of students of the project's participating teachers have been analyzed during Phase II.

Reading comprehension tests as measures of thinking skills. In deciding to use the standardized tests of reading comprehension as the student outcome measure of the attainment of student objectives in terms of academic achievement, some important assumptions were made. First, it was assumed that there were no available tests specifically designed to measure the scope of thinking abilities developed in Project THISTLE which were within the ability of the average student in the program; such tests as the Watson-Glaser Test of Critical Thinking were deemed too difficult and too narrowly focused for effective use. Second, it was assumed that tests of reading comprehension do, in fact, measure cognitive skills; on the high school level, they represent a measure of the application of intellectual skills--thinking skills--to general content area tasks. And third, it was assumed that problems that students have in making inferences, drawing conclusions, reasoning, analyzing problems, considering various perspectives, taking alternative positions on issues, and organizing and expressing ideas would be reflected in--if not measured directly by--tests of reading comprehension, and result in impaired performance on these tests.

Content analyses of secondary school level standardized test items in the basic skills and content areas reveal that it would be extremely difficult to

distinguish among items selected from tests designed to measure achievement in reading comprehension, science, or social studies. Tests of mathematics concepts generally are distinguishable by the use of numbers; however, even in such tests, the prerequisite arithmetic skills are extremely simple and items testing mathematical concepts are, in part, measures of verbal comprehension skills. In one widely used test series, the prose passages used as stimuli on the reading comprehension subtest *all* deal with science and social studies content; many prose passages within the science and social studies achievement subtests parallel reading comprehension items and some, indeed, might equally well appear in tests of reading comprehension.

Statistical analyses of such tests, too, reveal that an underlying verbal comprehension factor explains much variance in test performance. It was hypothesized that the development of skills in language and cognitive comprehension--in creative, logical and critical thinking--would improve such performance.

The particular test used as a measure of reading comprehension was the Comprehensive Test of Basic Skills (CTBS), administered on an annual basis by the Newark school system. In keeping with our general principle that the ongoing processes of the school were to be respected, it was decided to use the available test scores rather than imposing our own testing program.

Analyses of Student Achievement Data

At the completion of Phase II, pretest and posttest standardized test scores in reading comprehension were recorded for tenth, eleventh, and twelfth grade students of the project's participating teachers. These data were collected in 1981 for students of THISTLE I teachers; scores on the reading comprehension subtest of the CTBS administered in April, 1980 were used as pretest, and those on the CTBS administered in April, 1981 served as posttest. Parallel data were collected in 1983 for students of THISTLE II teachers; 1982 and 1983 test scores were used as pre- and posttests, respectively. Follow-up data were also collected in 1983; data were recorded for THISTLE I teachers' students who were still in high school and who were tested in 1982 and 1983.

Pretest-posttest comparisons. Historical regression analyses were employed for each pretest-posttest comparison. This analysis involves the assumption that the average rate of growth for a group would be expected to remain constant unless Project THISTLE (or some other special project) was indeed effective in improving student achievement. A predicted rate of growth was calculated for each student, based on the student's prior average rate of growth in reading comprehension over the years he or she had been in school at the time of pretest; it is based on his or her grade level in school and pretest score in grade equivalents. The predicted rate of growth was then used to estimate a predicted posttest score for each student. The average predicted and actual posttest scores were then compared statistically, using correlated *t*-tests of the significance of the difference between means.

Table 1 presents the means of the pretest scores, predicted rates of growth (gain), predicted posttests, actual gains, and actual posttest scores for students of THISTLE I (1980-81) and THISTLE II (1982-83) teachers.

Table 1

Student Improvement in Reading Comprehension
During Project THISTLE Participation

Grade Level	N	Pretest Mean	Pretest SD	Pred. Gain	Pred. Posttest	Actual Gain	Posttest Mean	Posttest SD
				1980-81 Analysis				
10	149	7.80	1.60	.69	8.49	1.29	9.09	2.01
11	174	7.49	2.14	.60	8.09	1.30	8.79	2.48
12	155	7.58	2.03	.56	8.14	.92	8.50	2.48
Total	478	7.62	1.96	.61	8.23	1.17	8.79	2.36
				1982-83 Analysis				
10	122	7.32	2.14	.65	7.97	1.84	9.16	1.75
11	69	8.09	2.05	.66	8.75	1.61	9.70	1.81
12	21	8.04	2.19	.60	9.39	1.35	9.39	2.59
Total	212	7.64	2.14	.64	8.28	1.72	9.36	1.88

The t-tests of the significance of the difference between mean predicted and actual posttest scores were 17.51 ($p < .001$) for the 1980-81 data and 7.60 ($p < .001$) for the 1982-83 data. Within the limitations of this type of single group statistical design, it was concluded that Project THISTLE has been successful in raising students' reading comprehension over the period of their participation. The replication of the data analysis, with the same results, lends strong support to this conclusion.

Follow-up data analyses. In 1983, data were collected for students who had served as tenth grade "subjects" in the earlier 1980-81 pretest-posttest analysis of their reading comprehension scores. Full sets of scores for a total of 77 of the original 149 students (52%) were located. The progress of these Project THISTLE students from ninth through twelfth grade is presented in Table 2 for each of the three participating schools. The mean scores for each of these schools is also presented, for purpose of comparison.

Table 2

Follow-Up Mean Scores in Reading Comprehension
1980-81 Grade 10 Project THISTLE Participants

	N	School A	School B	School C	Total
Grade 9 (1980)					
School		5.9	5.6	6.0	
THISTLE	23	7.65	7.97	7.76	7.76
Grade 10 (1981)					
School		6.7	5.9	6.9	
THISTLE	13	8.56	9.29	8.76	8.79
Grade 11 (1982)					
School		7.4	6.8	7.9	
THISTLE	41	9.53	9.76	9.44	9.52
Grade 12 (1983)					
School		9.4	9.3	9.5	
THISTLE	77	10.99	10.10	11.05	10.87

The data presented in Table 2 indicate that Project THISTLE students, on the average, achieved and maintained a normal rate of growth through their high school years. Although they completed their studies below grade level, on the average, they were substantially ahead of the average student in their schools.

Summary

Project THISTLE: Thinking Skills in Teaching and Learning was developed by Montclair State College faculty in collaboration with the public schools of Newark, New Jersey. It was designed to improve the basic skills of urban college-bound high school students, and thus their chances of success in college, by working with their teachers in an integrated process of curriculum and staff development. Since 1980, more than 100 Newark teachers have participated in Project THISTLE's program of graduate course work in curriculum development and basic skills instruction, supervised classroom implementation, and elective professional development activities. Hundreds more have engaged in less intensive Project THISTLE activities.

Project THISTLE, funded in part by the New Jersey Department of Higher Education and several local foundations, cuts across disciplines to focus on thinking as an essential, integral part of both subject area learning and "higher order" basic skills development, particularly reading comprehension, analytic writing, and mathematical reasoning and problem solving. Project THISTLE helps classroom teachers in the various disciplines to develop more thoughtful, consistent versions of their own curricular plans, with particular attention to the development of students' thinking skills.

Improvement in thinking skills would, it was expected, be reflected in improved performance on traditional standardized tests of basic skills, as well as in the classroom. Students of Newark teachers, in grades 10-12, doubled their annual growth rate in reading comprehension, from an average rate of six months in a ten-month period to a rate of twelve months, demonstrating the effectiveness of the project.

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APPENDIX

REASONING (REFLECTIVE THINKING) SKILLS

I. Formulating concepts

1. Making distinctions
2. Making generalizations
3. Formulating definitions

II. Making connections

1. Identifying cause-effect, part-whole and other logical relationships
2. Recognizing consistencies and contradictions
3. Making inferences
4. Understanding figurative language
5. Judging relevance

III. Generating ideas

1. Predicting outcomes
2. Generating possibilities
3. Generating metaphors and analogies

IV. Formulating informal arguments

1. Posing questions
2. Giving reasons
3. Giving examples and illustrations
4. Making comparisons
5. Drawing conclusions
6. Summarizing

V. Formulating formal arguments

1. Considering contexts
2. Constructing formal hypotheses
3. Identifying assumptions and fallacies
4. Applying criteria in forming judgments